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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/791,966 | 03/03/2004 | Dennis M. Brunner | 59522US003 | 5098 |

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| EXAMINER | |
|---|---|
| PAREKH, NITIN | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2811 | |

DATE MAILED: 06/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/791,966 | BRUNNER ET AL. | |
| | Examiner | Art Unit | |
| | Nitin Parekh | 2811 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *12 May 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) *24-27* is/are withdrawn from consideration.

5)☒ Claim(s) *11-23* is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *08-02-04,09-27-04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Election/Restriction*

1. Applicant's election with traverse of the Group II, claims 1-23 in Paper No. 3 is acknowledged. The traversal is on the ground(s) that in the requirement for an election, Groups I and II differ only in a semiconductor device and method for making the same. Requiring an election based on the above-noted differences would appear to be unwarrant since the fields of search appear to be almost identical. This is not found persuasive because referring to the restriction requirement set forth in the Office Action paper no.2, it clearly shows that the alternative method proposed by the examiner would be distinct from the process claimed. Additionally, the search is not coextensive as evidenced by the different fields of search for the process and product as cited in the previous restriction requirement. Furthermore, Applicant has not provided a convincing argument that the materially different processes would not be suitable in producing the claimed device.

The requirement is still deemed proper and is therefore made FINAL.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hishinuma et al. (US Pat. 6848176) in view of Hirose (US Pat. 6097097).

Regarding claims 1, 2 and 4, Hishinuma et al. disclose a process for forming an array/plurality of conductive bumps attached to a dielectric/resin film (see Fig. 1a-1i), the process comprising:

- providing a photo exposable mask/film (13 in Fig. 1c) having a first/top side, a second/bottom side and a plurality/array of vias filled by a metal/copper plug (15 and 16 respectively in Fig. 1C) having an exterior surface exposed at the first/top side of the photo exposable mask/film, and
- controllably etching photo exposable mask/film film (see Fig. 1e-1f) from around the exterior surface of the metal plug to provide a polyimide/dielectric film (see 20 in Fig. 1g-1i) having the metallic projection protruding therefrom

(Fig. 1a-1i; Col. 3, line 50- Col. 5, line 5).

Hishinuma et al. father disclose using a conventional dielectric film/polyimide material as a photo exposable film (see 111 in Fig. 4a-4c; Col. 1, lines 20-35).

Hishinuma et al. fails to teach the metal plug having a planar exposed surface.

Hirose teaches a process for forming an array/plurality of conductive bumps/pillars/plugs wherein the bumps/pillars/plugs have planar/coplanar surface (see

34 in Fig. 3C) and have a metal pad (see 35 in Fig. 3C) conventionally deposited/electroplated on the planar surface to produce the desired extension on the conductive bumps/pillars/plugs (Col. 6, line 55- Col. 7, line 8).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the metal plug having a planar exposed surface and the plug having the metal to provide the desired extension form the metallic projection to cover a portion of the etched surface as taught by Hirose so that the desired contact area/profile of the protrudes metal can be achieved and the reliability of metal interconnect can be improved in Hishinuma et al's process.

Regarding claim 3, Hishinuma et al. and Hirose teach substantially the entire process as applied to claim 1 above, wherein Hishinuma et al. teach the plurality/array of the metal plugs and the controlled etching (see Fig. 1d-1i) providing the plurality/array of the metal plugs metallic projections surrounded by the polyimide/dielectric film (see 16 and 20 respectively in Fig. 1i).

4. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hishinuma et al. (US Pat. 6848176) and Hirose (US Pat. 6097097) as applied to claim 1 above and further in view of admitted prior art (APA).

Regarding claim 5, Hishinuma et al. and Hirose teach substantially the entire process as applied to claim 1 above, except the dielectric film comprising a polymer selected from the group consisting of polycarbonate polymers, liquid crystal polymers and polyimide copolymers including carboxylic ester structural units in the polymeric backbone.

The APA teaches a dielectric film comprising conventional polymers including polyimide, liquid crystal polymer (LCP), etc. to achieve the desired properties (see specification pp. 1 and 2).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the dielectric film comprising a polymer selected from the group consisting of polycarbonate polymers, liquid crystal polymers and polyimide copolymers including carboxylic ester structural units in the polymeric backbone the as taught by the APA so that the desired dielectric properties can be achieved and the reliability of metal interconnect can be improved in Hirose and Hishinuma et al's process.

5. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hishinuma et al. (US Pat. 6848176) and Hirose (US Pat. 6097097) as applied to claims 1 and 5 above, and further in view of admitted prior art (APA) and Uchida et al. (US Pat. 5248446).

Regarding claim 6, Hishinuma et al., Hirose and the APA teach substantially the entire process as applied to claims 1 and 5 above, except the liquid crystal polymers being selected from the group consisting of copolymers containing p-phenyleneterephthalamide and copolymers containing p-hydroxybenzoic acid.

Uchida et al. teach a variety of liquid crystal polymers (LCP) compositions including those comprising copolymers containing p-hydroxybenzoic acid (see Col. 18, lines 40-45, Col. 20, lines 50-65, Col. 3-60) to achieve the desired polymer properties.

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the liquid crystal polymers being selected from the group consisting of copolymers containing p-phenyleneterephthalamide and copolymers containing p-hydroxybenzoic acid as taught by Uchida et al. so that the desired polymer properties can be achieved and the reliability of metal interconnect can be improved in the APA, Hirose and Hishinuma et al's process.

6. Claims 7-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hishinuma et al. (US Pat. 6848176) and Hirose (US Pat. 6097097) as applied to claims 1 and 5 above and further in view of admitted prior art (APA), Fujihara et al. (US Pat. Application Pub. 2004/0097694) and Ono et al. (US Pat. Application Pub. 2004/0094512).

Regarding claims 7-10, Hishinuma et al., Hirose and the APA teach substantially the entire process as applied to claims 1 and 5 above, except polyimide copolymers comprise the reaction product of monomers including p-phenylene bis(trimellitic acid monoester anhydride).

Fujihara et al. teach polyimide film compositions comprising copolymers including reaction product of monomers including p-phenylene bistzmellitic acid monoester anhydride (section 0052) and the polyimide dielectric being conventionally etched using alkali metal hydroxide/KOH (section 0013).

Ono et al. teach polyimide being conventionally etched using etchants/chemical milling reagents including alkali metal hydroxide/KOH and amines including ethanolamine (sections 0056, 0177, 0178, etc.).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the polyimide copolymers comprise the reaction product of monomers including p-phenylene bistzmellitic acid monoester anhydride and the etching of the dielectric film being performed using the chemical milling reagent including an alkali metal hydroxide such as potassium hydroxide/KOH and an amine such as ethanolamine as taught by Fujihara et al. and Ono et al. so that the desired dielectric properties/etch rate can be achieved and the reliability of metal interconnect can be improved in the APA, Hirose and Hishinuma et al's process.

***Allowable Subject Matter***

7. Claims 11-23 are allowed.

***Reasons for Allowance***

8. The following is an examiner's statement of reasons for allowance:

The references of record do not teach either singularly or in combination at least the limitations of process steps for forming a protruded bump from a dielectric film "providing a dielectric film"; "applying a stop layer to at least a first side of said dielectric film, said stop layer having an underside in contact with said first side of said dielectric film; forming a cavity in the dielectric film that extends through said dielectric film from a second side of said dielectric film to said stop layer" or "forming an opening in the dielectric film extends through said dielectric film from said first side to said second side of said dielectric film; applying a stop layer to said second side of said dielectric film such that said opening is closed off by the stop layer on the side of the opening adjacent the second side, thereby forming a cavity", and "depositing conductive material to form a conductive plug in said cavity; removing said stop layer from said first side of said dielectric film to expose a surface of said conductive plug; and controllably etching said dielectric film from around said conductive plug surface to form said conductive bump protruding from said dielectric film".

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number is 571-272-1663. The examiner can normally be reached on 09:00AM-05:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9318.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAN or Public PAG. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAG system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Nitin Parekh

NP

NITIN PAREKH

06-21-05

PRIMARY EXAMINER

TECHNOLOGY CENTER 2800